Rice (C. C.)

ATROPHIC CATARRH.-A New Method of Treatment.

THE USE OF OZONE IN ATROPHIC CATARRH.

By CLARENCE C. RICE, M. D.

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THE OZONE COMPANY,

122 EAST 23RD ST., NEW YORK.
SUITE 1115, MASONIC TEMPLE, CHICAGO.

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THE USE OF OZONE IN ATROPHIC CATARRH.

By CLARENCE C. RICE, M. D.

THIS paper will necessarily be a short one, since what can be said of the chemical composition, physical properties, and therapeutic value of ozone can be easily read in any chemistry or in pamphlets compiled by the Ozone Company of New York. I have used ozone only during the past two months, and while I cannot speak decidedly of its value in the treatment of catarrhal diseases, the results so far have been satisfactory enough to warrant calling the attention of this association to its use in atrophic catarrh.

Dr. William J. Morton, of this city, for whom the Ozone Company have manufactured an extensive apparatus for the generation of ozone, and who has used it for various purposes during the past year, first called my attention to the use of ozone in catarrhal disease of the upper air passages, and alleged a therapeutic value for it. Before speaking of the therapeutics of ozone and the method of using it in catarrhal disorders, I may give a short history of what is known of its

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chemical composition and physical properties and describe the methods used for its manufacture. I am indebted to the Ozone Manufacturing Company of this city for the larger apparatus which they have placed here for your inspection, and to Dr. Augustus Caille, of this city, who has loaned me the smaller apparatus of Messrs. Labbe and Oudin.

Physical and Chemical Properties of Ozone. —In 1775 Van Marum noticed that the passage of an electrical discharge through the atmosphere produced a peculiar odor, but the reason of this was not discovered until 1840, when Schœnbein observed that this same odor accompanied the process of electrolysis in acidulated water. He discovered, too, that these odoriferous gases had the power of decomposing iodide of potassium and liberating iodine. By experimentation it was found that ozone was similar to, though quite different from, chlorine. The credit of discovering the true composition of ozone is due to Marignac and De la Rive, who demonstrated that ozone could be obtained by simply passing a current of electricity through pure oxygen gas. In this way it became apparent that ozone could be nothing else than an allotropic modification of oxygen. Schœnbein named this peculiar gas ozone, from the Greek word "ozein", which means "to emit an odor." The knowledge of the present day in regard to the relation between the two kinds of oxygen—O_2 and O_3 —has been derived principally from the writings of Professor Tait. As is well known, the chemical formula for ozone is O_3 and it is an allotropic form of oxygen, just as carbon may be found in the allotropic forms of

charcoal, graphite, and the diamond. Oxygen may exist in the different forms of O_1 or active oxygen ; O_2 or common oxygen, and O_3 or ozone. In the formation of ozone three volumes of oxygen are condensed to form two volumes of ozone—that is, $3O_2 = 2O_3$. In volume, then, it bears the relation to oxygen of 2 to 3. Common oxygen, O_2, when coming in contact with active oxygen, O_1, becomes concentrated into ozone, or O_3. Ozone has been called ozonized air, ozonized oxygen, and electrified oxygen.

From Sir Benjamin Brodie's experiments (*Proceedings of the Royal Society*, 1892, p. 435) it is positive that ozone differs from ordinary oxygen merely in the fact that its molecule contains three atoms instead of two, O–O being oxygen.

O
^ being ozone.
O—O

Ozone is a colorless gas, quite similar in chemical properties to chlorine. It will liquefy at a temperature of 105° under a pressure of 125 atmospheres, and in this form is of a deep blue.

At one time Schœnbein advanced the theory, and it was generally believed, that ordinary oxygen gas was a compound made up of two kinds of oxygen, one being positively and the other negatively electrical. Marignac observed that when oxygen was exposed to the influence of electricity it underwent a contraction in volume and acquired very different properties, its chemical activity being greatly increased.

The ordinary way of obtaining ozone is by means of a Siemens induction tube, which consists of two tubes of nearly the same diameter,

one within the other. Their exterior surface is covered with tin foil, and this tin foil is connected with the electrodes from an induction coil. The current of oxygen is passed through the space between the two tubes, and is thus exposed to the electrical current. It is said to be very essential that the oxygen which is to be ozonized should be very pure and very dry. Ozone may also be obtained in small quantities by decomposing water with the electric current. Ozone has remarkable oxidizing power. It destroys substances like rubber, paper, etc. Its effect upon mercury is to deprive it of its mobility so that it will adhere to the surface of a mirror glass. The books tell us that ozone in Nature is principally formed by the action of the sun's rays on oxygen. Schœnbein maintains that ozone is the great purifier and oxidizer in the atmosphere, and in a large measure prevents decomposition.

The Ozone Company pamphlet tells us that the utility of ozone as a disinfectant is hinted at by its early discoverer, Schœnbein, who in 1851 (*Zeitschrift fuer nat. Medizin*, Bd. xv, 391) maintained that one part of ozone to 340,000 parts of air was sufficient to destroy the odor of decay in a vessel of 60 litres capacity in which 120 grammes of putrid meat had been placed for a minute, and that Wood and Richardson forced ozonized oxygen through blood in course of decay, and noticed that by this means the blood completely lost its offensive smell.

The value of ozone as a bactericide is now under trial by Dr. W. J. Morton and Dr. W. C. Park. I have seen the results of their experiments, but they will be published by these gentle-

men later on. Dr. W. Wyssochowicz has recently stated, in regard to experiments with bacterial cultures in ozonized nutrient media, that the ozone effected a change in the nutrition furnished the cultures which prevented their propagation.

The large apparatus for manufacturing ozone, which has been placed at our disposal to-day by the Ozone Company, consists of a dynamo, a blower, a transformer, and an ozone generator proper. The dynamo supplies the current, which then passes for conversion to the necessary high potentiality to the transformer, from which it is conducted by suitable connecting wires to the ozone generator. This latter is constructed of four ozone tubes, placed round and connected by tubes to a central metal pipe, through which the air is received from the blower. The air, passing from thence to the ozonizers, becomes ozonized by the silent electric discharge or effluvium which takes place through the walls of the concentric glass tubes. The blower, driven by a small belt from the dynamo, supplies the air to be ozonized, which, before reaching the generator, is forced through the drying tube. The latter is filled with glass in fine pieces, moistened with sulphuric acid. Ventilators are provided in the sides of the cabinet, containing and supporting the different parts of the apparatus. [These are operated by screwing in and out, and they serve to carry off the heat generated by the dynamo when in motion.] The longer the air is exposed to the electric effluvium, the greater is the quantity of ozone produced. The flow of the air may be regulated by the valve which will be found at the lower end of the glass tube, conveying the air to

the generator. [The blower being provided with a blow-off valve, there is no danger to the apparatus from overpressure.] Experience will soon establish the amount of air necessary to obtain the most satisfactory results. When generating ozone, the tubes of the generator should show, in a darkened room, the blue light of the electric discharge or effluvium. The absence of this light shows that either the commutator or drying tube requires attention. Should the ozone be found too irritating, pass the ozonized air through a two-necked Woulfe's bottle containing a solution of caustic potash—a pound of caustic potash to the gallon of water.

The smaller ozone generator which I present to the association was constructed by Dr. Labbe and Dr. Oudin, and has kindly been sent to me by Dr. Augustus Caille, of this city. Dr. Caille has used this instrument quite extensively, and published his observations of its use in a paper entitled Experiments as to the Value of Nascent Ozone in Certain Forms of Diseases of Children, with Demonstration of an Efficient Generator. Dr. Caille says of this ozone generator that it is made up as follows; "A mild electric current, from a zinc-carbon cell or storage battery, is sent into a Ruhmkorff or spark coil, and from there enters the inhaler, which is a double cylinder of glass, the inner cylinder being closed and holding an aluminium plate *in vacuo* and surrounded by an aluminium cone. The electrical discharge is not in the form of a spark, but presents a diffuse electrical glow." I suppose that the aluminium tin foil simply acts as a conductor for the electrical current, and thus presents a large electrified surface to the oxygen.

Dr. W. J. Morton began to use ozone in cases of nasal catarrh without special regard to the kind of nasal disease. The method employed has been to instruct the patient to take a deep inspiration, and then hold the breath while the ozone gas is allowed to pass into the nostrils through the tube. The current of ozone is passed as long as the patient can hold his breath. The patient is then instructed to blow the ozone out of the nostrils before taking the first inspiration of atmospheric air. The degree of irritation produced by ozone upon the nasal and pharyngeal mucous membrane is in proportion to the volume of gas employed, and depends also on the purity of the gas used. One of the patients accidentally inspired a strong current of ozone, and the next day suffered from an aphonic laryngitis.

Ozone in condensed form irritates the respiratory mucous membrane, and may cause active acute inflammation, etc. In Dr. Caille's paper, already referred to, he states that Messrs. Labbe and Oudin have published extensive experiments in the use of ozone, and that they allege for its use, first, increased metabolism in consequence of the high oxidizing power of ozone, and, second, the destruction of the tubercle bacillus, in consequence of the oxidizing power and diffusibility of ozone, and its ability to reach directly and indirectly the foci of disease in the lung.

Dr. Caille's experiments with ozone were employed to test its efficacy in the first stages of pulmonary tuberculosis, in extreme anæmia, and in pertussis. His observations extended over five months and comprised twenty-two cases. His conclusions are: That the daily inhalations of

ozone increase the oxyhæmoglobin in the blood from two to four per cent. in a short time; that no local improvement was obtained in three typical cases of limited apex tuberculosis, but that, in pertussis, ozone inhalations have a distinct curative effect as regards the duration and severity of the disease. Also that, in anæmia, ozone inhalations are exceedingly valuable from a therapeutic standpoint, and give better and prompter results than any other form of medication. And, lastly, that atmospherical disinfection is readily secured by means of the ozone current, making this probably a valuable procedure in the treatment of diphtheria, scarlet fever, and other infectious diseases.

Before calling your attention to my own cases I wish to refer to a paper written by Henry S. Norris, M.D., of this city. The title of this paper is The Internal Administration of Ozone in the Treatment of Phthisis, with a Report of Cases.* The report has no special bearing upon the object of this paper, except as it shows that the general tone of the patients treated with ozone was improved. The report covers fifteen cases, fourteen of which are put down as catarrhal phthisis and one as fibroid phthisis. The inhalation of ozone gas was not used in these cases, but aquzon and ozonized cod-liver oil were administered. The aquzon was given, four doses daily of three ounces each, before meals, and half an ounce of the oil containing six volumes per cent. of ozone after each meal. The results in many of the cases were beneficial.

* Norris. *New York Medical Journal*, November 5, 1892.

Speaking now of the effect of ozone gas when admitted into the nostrils of patients suffering from nasal disease, I may say that the first case I observed was treated by Dr. W. J. Morton. He treated this case for the purpose of checking a profuse nasal discharge.

It was a boy of twelve years of age who suffered from apparent nasal obstruction and constant nasal discharge so irritating in character as to keep the upper lip constantly excoriated. He used ozone gas in the nostrils two or three times weekly, covering a period of a few weeks, and the result was that the discharge was almost entirely stopped, the inflamed lip cured, and the patient breathed better through the nose. The patient was sent to me for examination, and I found it to be a case of rather marked adenoid enlargement in the vault of the pharynx. The entire mucous membrane was quiescent at the time I saw him.

I wrote Dr. Morton that in such a case I did not think ozone was as applicable as in atrophic rhinitis, as I believed that the removal of the adenoid would entirely relieve both the nasal obstruction and the pent-up secretions of the nose. It seemed to me that if ozone possessed the powerful oxidizing, germicidal, and bactericidal properties alleged for it, its use would be indicated in those forms of nasal disease which were characterized by decomposing secretions and degenerating tissues, the entire condition possibly depending upon the action of nasal bacteria. Since then Dr. Morton and I have employed the local effect of the ozone gas upon eight different patients, all of them suffering from various grades of atrophic rhinitis and dry pharynx. Of these eight patients, three were treated at the office of Dr. Morton, and he has used a much larger amount of ozone

gas than I have at my office. Dr. Morton's apparatus was, as I have said, manufactured by the Ozone Company, while the apparatus at my command is that of Labbe and Oudin. I had the smaller apparatus connected with the storage cells of my cautery battery, and have my patients breathe it into the nose and lungs and exhale it through the mouth. With Dr. Morton's apparatus the current of ozone gas is so strong as to be too irritating for inhalation into the lungs, although it can be modified to any degree. It is hardly necessary to give a detailed history of the cases—that is, the pathological condition in each case—because they are all very much alike.

Three of my cases were advanced to an extreme condition of atrophic change, so familiar to all of you. In two the turbinates had almost entirely disappeared. The sæptum was ulcerated, and the secretions were collected in thick scabs. Of the two cases I sent to Dr. Morton's office, one was far advanced in atrophic change and the second was but moderate in degree. All of the cases were treated with ozone gas from five to eight minutes. In Dr. Morton's cases the gas was passed into the nostrils three times—that is while the patient was holding the breath for three different periods. The immediate effect of the ozone gas was alike in kind in all the cases, but differed in degree according to the volume of the gas employed, and probably according to the sensitiveness of the nostrils. It produced a mild smarting of the nasal mucous membrane for several hours. It increased the secretions of mucus very markedly for eight or ten hours. The congestion of the mucous membrane of the nose was

also exaggerated. In some of the cases, where the volume of gas was large, the patients complained of headache, which, however, had disappeared by the following day. It was almost the universal testimony of these patients that the nasal pharyngeal mucous membrane was less dry, and that the tenacious secretions were more easily got rid of. For the first twenty-four hours after the ozone was used the patient had the symptoms of a cold in the head, but after that the nose felt unusually clear and the mucous membrane more comfortable than before the application of ozone.

The milder cases of atrophic catarrh were very quickly benefited, and remained improved for several days after the inhaling of ozone, but most of them relapsed somewhat. The benefit was again obtained, however, by the further treatment with ozone. Whether permanent moistening of the mucous membrane and decrease of secretions can be obtained by the use of ozone can be told only after a longer trial. In the more severe cases the benefit was not obtained so quickly. In all the cases we instructed the patient to discontinue the use of all sprays and douches while we were using the ozone. In a case of ozæna treated by this method the deodorizing power of the ozone seemed to be as marked as is obtained by the use of peroxide of hydrogen. The odor from the nostrils was very fœtid, but disappeared altogether after the second inhalation of ozone gas. I have used a preparation called by the Ozone Company "THERAPOL," a combination of sweet oil and 8·75 volumes per cent. of ozone, applying it locally on cotton, with an applicator,

in two cases of ozæna, with the result of deodorizing the nostrils.

As to the manner in which ozone may be expected to produce beneficial results in atrophic disease of the upper air passages, it is known that ozone is an active oxidizing agent, furnishing the active O_1, which is ever ready to seize upon and form itself into new combinations. Upon this oxidizing power its germicidal properties may be based. It is possible that in atrophic rhinitis there may be bacteria of a peculiar variety, the destruction of which, if it can be accomplished by ozone gas, will tend to greatly ameliorate the disease. Possibly the irritation produced, which we usually term stimulation, is of therapeutic value.

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